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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/530,968	05/19/2000	JEAN-CLAUDE GROSSETIE	JEK/GROSSETI	6299

7590 01/26/2006

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EXAMINER	
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ART UNIT	**PAPER NUMBER**
2872	

DATE MAILED: 01/26/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/530,968	GROSSETIE ET AL.	
	Examiner	Art Unit	
	Audrey Y. Chang	2872	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-25* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-25* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on **November 29, 2005** has been entered.

2. This Office Action is in response to applicant's amendment filed on November 29, 2005, which has been entered into the file.

3. Claims 1-25 remain pending in this application.

Response to Amendment

4. The amendment filed **November 29, 2005** is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: **claims 1 and 14 have been amended** to include the phrase "*illuminating* the oversampled complex image by an optical wave (DIF)". The specification only teaches to ***simulate*** the illumination of the optical wave (DIF) on the complex image or using a *fictitious* coherent wave DIF to illuminate the complex image, (please see specification page 6 line 28-30, page 12, lines 28-31). There is support for using a real, physical illumination to the complex image.

Applicant is required to cancel the new matter in the reply to this Office Action.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. **Claims 1-25 are rejected under 35 U.S.C. 112, first paragraph**, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The reasons for rejection based on the newly added matters are set forth in the previous paragraph.

7. **Claims 1-25 are rejected under 35 U.S.C. 112, first paragraph,** as failing to comply with the **enablement** requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The phrase "computing a set of two-dimensional images representing the object as seen from respective different viewpoints in the three-dimensional geometric space each of said two-dimensional images representing the object as seen from one of said different viewpoints in the three-dimensional geometric space" recited in **claims 1 and 14** is **not enable** by the specification. The specification **fails** to teach that the set of two-dimensional images are produced at ANY place in the three dimensional geometric space and it **fails** to teach that the two-dimensional images used to calculate the elementary holograms are viewed from ANY viewpoints in the three-dimensional geometric space. Rather the specification **ONLY** gives support for the two dimensional images being defined in a *particular first geometric plane* and the images are defined by viewing the object from different view points **located in a specific** *second* geometric plane, wherein the first and second geometric planes are parallel to each other, so that the set of two dimensional images is determined by the *projection* of the object on the first

geometric plane as viewed from the plurality of different viewpoints on the second plane. Off from this condition, the elementary holograms cannot be formed to reproduce the object, (please see Figure 4 and pages 2-3). The specification also does not give any support for producing the hologram from conditions different from the above-mentioned condition.

8. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

9. **Claims 7-8 and 19-20 are rejected under 35 U.S.C. 112, second paragraph,** as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 7 and 19 recite the phrase "**said** simulation step (E53) including the computation of at least one of the following complex transformations" that is really confusing and indefinite. **Firstly**, the phrase "**said** simulation step" is indefinite since it lacks proper antecedent basis from its based claim. **Secondly**, the claims are not complete since it is not clear the complex transformation is performed upon what? Complex transformation is a mathematical function and without specifying what is being transformed by the complex transformation the transformation is NOT complete. **The specification further FAILS to provide the support for the complex transformation to be applied on ANYTHING**. The claims therefore need to specify **what** is being transformed by this complex transformation.

Claims 8 and 20 are really confusing as to **what exactly are the functions** that are involved in the convolution product?

A ***convolution*** is defined as: f(x) = INT(g(u)h(x-u)du), with INT refers to integral between (negative infinity to positive infinity). It is a measure between the correlation between to functions g(u)

and h(u). It is not clear what are the "complex transform" and "a inverse complex transform to the product of respective complex transforms of said two functions" with respect to the "convolution" here.

Judging from the specification, it is believed that the following is intended:

Calculating a diffracted image (84_{mn}) by *simulating* the illumination of the oversampled complex image (83_{mn}) by an optical wave (DIF), (as in claims 1 and 14).

The calculation step comprises calculating a convolution product of the oversampled complex image (83_{mn}) and the optical wave (DIF) wherein the convolution product is obtained by *first* performing a complex transformation on the complex image and on the optical wave *respectively* and an inverse complex transformation of the product of the transformed complex image and the transformed optical wave is performed to obtain the diffracted image, such that the inverse complex transformation being the inverse of the said complex transformation, (please see page 13 of specification). The complex transformation is at least one of the "Fourier transformation ....".

Claim Objections

10. Claims 1-25 are objected to because of the following informalities:

(1). The symbols O, x,y,z and $f_{nm}(Y, Z)$ recited in claims 1 and 14 are not defined which makes the scopes of the claims unclear.

The phrase "each of said two-dimensional images is defined by a real function $f_{nm}(Y, Z)$" is better to be phrased as "the *intensity* profile of a projected image of each of said two-dimensional images on a second geometric plane having coordinates (Y, Z) is defined by a real function $f_{nm}(Y, Z)$".

(2). The phrase "illuminating the oversampled complex image by an optical wave (DIFO to obtain a diffracted image" should be better versed as "*Calculating* a diffracted image (84_{mn}) by *simulating* the illumination of the oversampled complex image (83_{mn}) by an optical wave (DIF)".

(3). The phase "the complex image" recited in claims 1 and 14 is vague and indefinite since its antecedent basis is not clear. The step "converting (E50, E51) the two dimensional image" should some how generate the complex image.

(4). The phrase "extracting (E6) amplitude values of the sum of said complex field and the resulting diffracted image to produce hologram" recited in claims 1 and 14 is wrong the hologram is not produced by the amplitude values of the sum but rather it is the amplitude values of the **interference field.**

Appropriate correction is required.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 1, 4, 6, 7-8, 9-13, 14, 19-20, and 21-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over the article "Fourier-transform computer-generated hologram: a variation on the off-axis principle" by Michelin et al (SPIE Vol. 2176, Practical Holography VIII (1994) pages 240-254) in terms of the patent issued to Saito et al (PN. 5,668,648).

Michelin et al teaches a computer-generated hologram to generate arbitrary optical wavefronts and to create image of *virtual* objects wherein elemental hologram is computed based on two-dimensional image information f (please see object plane, Figure 1) of the virtual objects. The two-dimensional image information f is sampled by a function f(x,y) on the object plane and it implicitly represents a perspective view of the object from a viewpoint in the three dimensional geometric space. Michelin et al teaches that that a Fourier transformation is performed on the image function f(x,y) to simulate the object beam, i.e.

the object information modulated beam, to obtain the diffracted image. The diffracted image $F(u,v)\exp(i\phi(u,v))$ is then added to a complex field $A\exp(2\iota\pi au)$ that represents a reference optical wave to produce the interference field, (please see page 250), such that by obtaining the amplitude of the sum of the complex field and the diffracted image the hologram is produced.

Although the Michelin et al reference does not teach explicitly to use a set of tow-dimensional image information for the object to calculate a plurality of elementary holograms, such modification would have been obvious to one skilled in the art since the modification only requires repeating the same calculation process for different two-dimensional image information for the benefit of producing a composite hologram from a composite two-dimensional image information.

This reference has met all the limitations of the claims with the exception that it does not teach explicitly that an oversampling step to the complex image is performed. The image information f is implicitly complex function. **Saito et al** in the same field of endeavor teaches a computer-assisted holographic display apparatus that is comprised of a *diffraction image computation section* (12) for receiving an input image data signal that represents a three dimensional object (20) and to compute the corresponding *diffraction pattern data* with a first sampling density. The apparatus further comprises *second computation section* that is connected to the diffraction image computation section to subject the diffraction pattern data to the *interpolation process* (28) so as to created *interpolated diffraction pattern data* with a *second sampling density* that is *increased* (i.e. an oversampling process), before the interference image or field is calculated, (14). It would then have been obvious to one skilled in the art to apply the teachings of Sato et al to modify the calculation step of Michelin et al by adding oversampling image processing step for the benefit of improving the image quality.

Saito further teaches, with regard to claims 10-11, 22-23 and 26 that the computer-generated holograms are displayed on a *spatial light modulator* (16, Figure 1) wherein light source may be used to physically reproduce the hologram image of the object. With regard to claims 12-13 and 24, light sources

of different color can be used to reproduce holograms of different colors, (please see Figure 12). It would then have been obvious to apply the teachings of Sato et al to represent the calculated hologram on the spatial light modulator to actually implement the hologram.

With regard to the feature (as recited in claim 6), concerning "said amplitude value each depending on the square root of a corresponding intensity value taken by the real function of the given two-dimensional image". Such feature is implicitly included in the wave theory of the image light, wherein intensity of the image light wave is the absolute square of the amplitude value of the wave function.

Response to Arguments

13. Applicant's arguments with respect to claims 1-25 have been considered but are moot in view of the new ground(s) of rejection.

Allowable Subject Matter

14. Claims 2-3, and 15-16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

15. The following is a statement of reasons for the indication of allowable subject matter: of the prior art references considered none has disclosed a method and system for producing a hologram from a virtual object defined in a three-dimensional space (x,y,z), wherein x, y, z representing the Cartesian coordinates, the method comprises the step of defining a first geometrical plane with a matrix of points defined within such that each of the points representing one of different viewpoints, defining a second geometrical plane parallel to the first plane, and computing a set of two-dimensional images corresponds to the projected images of the object on the second geometric plane as respectively viewed from each of said viewpoints distributed on the first plane. The method further comprises the step of computing a set

of elementary holograms each corresponding to one of said two-dimensional images. Each of the two dimensional images is defined by a real function (f_{mn} (Y,Z)) representing the intensity field of the image on the second geometric plane having coordinates (Y,Z). The method further comprises the steps of converting the real function into a complex function therefore form complex image, oversampling the complex image, computing diffracted image by simulating the illumination of an optical wave (DIF) on the complex image, calculating an interference field by adding the diffracted image with a complex field representing a reference optical wave (REF) and the step of extracting amplitude values from the calculated interference field to produce the hologram associated with said given two-dimensional image, as explicitly stated in claims 1 and 14.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Audrey Y. Chang whose telephone number is 571-272-2309. The examiner can normally be reached on Monday-Friday (8:00-4:30), alternative Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on 571-272-2312. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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